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MEMORANDUM FOR: Mr. Archibald S. Alexander
Assistant Director, Economics Bureau
U.S. Arms Control and Disarmament Agency
Washington, D. C. 20005

SUBJECT: Transmittal of Report

1. Attached is the report entitled, "Economic Consequences of Reduction in Soviet Military Expenditures Under ACOM Planning Assumption 3," which was prepared at your request.

2. You will note that this report deals explicitly with only one (No. 3) of the four planning assumptions in the original terms of reference dated 31 August 1964. However, Planning Assumption No. 2 is also discussed in this report because it is one element in Planning Assumption No. 3. It was agreed with members of your staff that the other two planning assumptions would not be included in this initial study.

3. If you wish to discuss any aspect of this report, please contact [redacted] Code 14 ext. 5291.

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WILLIAM N. MONELL, JR.
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ECONOMIC CONSEQUENCES OF REDUCTION
IN SOVIET MILITARY EXPENDITURES
UNDER ACDA PLANNING ASSUMPTION 3

ORR Project No. 13.4521

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ECONOMIC CONSEQUENCES OF REDUCTION
IN SOVIET MILITARY EXPENDITURES
UNDER ACDA PLANNING ASSUMPTION 3

Summary and Conclusions

Military spending by the USSR under ACDA's Planning Assumption No. 3 (PA 3) would decline from 18.2 billion rubles in 1965 to 15.8 billion rubles in 1970.* Nuclear weapons production would cease, and military expenditures other than RDTE&S** would decrease 10 percent annually for the three years, 1966-68, followed by a leveling off in 1969-70. In contrast, Soviet military spending without a disarmament agreement might maintain its share of GNP and increase from 18.2 billion rubles in 1965 to about 22.6 billion rubles in 1970. This latter alternative would represent a continuation of the present trend in Soviet military policy -- namely, to build up strategic capabilities, to modernize the large general purpose forces, and to pursue costly research and development programs on the frontier of military-space technology.

The difference in military spending under the two alternatives would be 6.8 billion rubles in 1970. For the whole period 1966-70 the cumulative difference would be 26 billion rubles. If not used in the military sector, these 26 billion rubles could be used to (a) modernize capital plant and thus raise the average annual rate of growth in GNP from 4.5 percent to 4.65 percent

* It was not possible to follow PA 3 in every detail, but the calculations in this report do represent close approximations to the stipulations of PA 3.
** Research, development, testing, evaluation, and space.

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in this period, or (b) boost per capita consumption by an average of 1.8 percent instead of 0.9 percent per year, or (c) a combination of these two. Whether or not PA 3 is adopted, the overall annual growth of factor productivity is set at 1.0 percent in this report because no transfer of the high-quality resources in RDTE&S is involved in the planning assumption. The following tabulation gives the growth in key economic variables under the alternative assumptions:

Annual Average Rate of Growth, 1966-70 (%)			
	No Agreement	Planning Assumption No. 3	
		Investment Variant	Consumption Variant
Input of Labor	1.8	1.8	1.8
Input of Capital	8.5	9.3	8.5
Input of Labor and Capital Combined	3.5	3.65	3.5
Factor Productivity	1.0	1.0	1.0
Gross National Product	4.5	4.65	4.5
Consumption, Per Capita	0.9	0.9	1.8

These estimates, which are based on a number of important assumptions described in the text, are less sanguine than those put forth by the Soviet leadership in the recently published five-year plan (1966-70). The plan implies an average growth rate in GNP of $6\frac{1}{2}$ to 7 percent and an average growth in factor productivity of about 3 percent.

Under PA 3, the Soviet planners would have to shift large amounts of resources from military to non-military use. In some instances -- such as in the

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aircraft and electronics industries -- re-allocation of resources would proceed smoothly. In other instances -- such as the missile industry -- part of the resources could be transferred rapidly to other uses whereas part would be highly immobile. In still other instances, such as the atomic energy sector, a large portion of the resources would find no ready or inexpensive alternative use.

In general, the effect on Soviet political economy of adopting PA 3 would not be critical. The USSR would continue to maintain a formidable military establishment, to modernize its industry and agriculture, albeit in quite spotty fashion, and to slowly improve the lot of the consumer. Having said this, however, it remains true that the adoption of PA 3 would result in a marked reduction in the pressures on the economy at the margin and in a considerable lessening of political tensions -- except from the marshals.

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I. Introduction

This report represents a general and tentative assessment of the economic impact of disarmament in the USSR during 1965-70, according to the terms of Planning Assumption No. 3 (PA 3) of the Arms Control and Disarmament Agency, dated 31 August 1964. Under PA 3, there would be a reduction of 10 percent in expenditures for most military items each year during 1966-68 and no change in expenditures during 1969-70. Exceptions are (a) nuclear weapons, the production of which would cease completely in 1966 and be prohibited through 1970; and (b) RDTE&S, which would be permitted to continue unrestricted, except that testing and evaluation of existing weapons would be restricted. Planning Assumption No. 1 (PA 1), which is not considered in this report, would require a freeze on production of strategic delivery vehicles during 1966-70. Planning Assumption No. 2 (PA 2) would require a complete cessation of nuclear weapons production, 1966-70; PA 2 is thus included as one element in PA 3. Planning Assumption No. 4 (PA 4), which is not considered in this report, requires a gradual reduction in defense expenditures until the point is reached by 1970 when the defense budget is \$12 billion less than the 1965 budget.

In order to assess the economic impact of PA 3, the defense budget of PA 3 is compared with the probable defense expenditures of the USSR in the absence of a disarmament agreement. The latter alternative would represent a

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continuation of the present trend in Soviet military policy -- namely, to build up strategic capabilities, improve general purpose forces, and pursue research and development programs in advanced weapons systems. Associated with this latter defense budget are projected growth rates in investment, gross national product (GNP), and consumption. The changes in these growth rates are then examined when PA 3 is substituted for the present trend in Soviet military expenditures.

Preliminary analysis suggests that under PA 1 military expenditures might not be reduced as rapidly as under PA 3. Under PA 4 the cumulative savings might be slightly greater than under PA 3; part of the savings under PA 4 would be in research and development, resources which would be exceptionally useful to the civilian economy. PA 2 by itself, would have only a small effect on military spending by 1970; PA 2 also appears as one element in PA 3. Within the broad analytical framework of this report, it is probable that the economic impact of PA 1 would be slightly less than that of PA 3, whereas the impact of PA 4 would be greater. Neither, however, would be markedly different from that of PA 3. A more detailed analysis would be required to sharpen the differences in impact among these three planning assumptions.

The calculations and results presented in this report should be treated circumspectly because of difficulties in methodology and data. Data on labor are subject to errors of measurement. Capital is elusive conceptually as well as

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empirically. Factor productivity, though a useful concept, is also difficult to define and to measure. It requires a system of weighting that is clearly arbitrary, and different assumptions give different results. In making projections little account can be taken of possible future changes in organization and technique, which may affect the various sectors of the economy in different ways. Therefore, it is not known exactly how the Soviet economy would perform given any particular shift of resources. The projections presented here are thus to be taken as illustrative, and they justify only the broad conclusion that PA 3 would not radically alter the course of Soviet economic development.

Section II of this report compares military expenditures under PA 3 with probable expenditures in the absence of a disarmament agreement. Section III discusses the impact of reduced military expenditures on the economy as a whole. Section IV presents some general observations about the impact of PA 3 on the major defense industries. Appendix A describes the method of calculating the GNP projections used in this report.

II. Military Expenditures Under Planning Assumption No. 3

Military spending by the USSR under PA 3 would decline from 18.2 billion rubles in 1965 to 15.8 billion rubles in 1970. In contrast, military spending without a disarmament agreement might maintain its share of GNP and increase from 18.2 billion rubles in 1965 to about 22.6 billion rubles in 1970.

(See Table 1, p. 7). The cumulative difference in military spending during

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Table 1

USSR: Alternative Levels of Military Expenditures,
1965 and 1970

		Billion rubles	
Category	1965	1970	
<u>No Agreement a/</u>			
Total	<u>18.2</u>	<u>22.6</u>	
RDTE&S b/	<u>4.1</u>	<u>6.1</u>	
Investment plus operating	<u>14.1</u>	<u>16.5</u>	
Investment	5.8	6.8	
Operating	8.3	9.7	
<u>Planning Assumption No. 3</u>			
Total	<u>18.2</u>	<u>15.8</u>	
RDTE&S b/	<u>4.1</u>	<u>6.1</u>	
Investment plus operating	<u>14.1</u>	<u>9.7</u>	
Investment	5.8	3.6	
Operating	8.3	6.1	

a. The total for 1970 is based on the assumption that military spending would grow at an average annual rate of 4.5 percent a year, thus maintaining its share in GNP. Division of the total among RDTE&S, investment, and operating expenditures is based on current trends, which suggest continuing growth in the share of RDTE&S.

b. Research, development, testing, evaluation, and space.

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during 1966-70 under these two alternatives would be about 26 billion rubles, or 50 percent more than total defense spending in 1965.

Under PA 3 the most pronounced annual decrease in total expenditures would occur in 1966, when procurement of nuclear weapons would be completely curtailed. (See Table 2, p. 9) Expenditures would reach their lowest level in 1968, but after that would begin to rise again as spending on military research and development continued to grow and other items became stabilized at their new low levels. Defense expenditures in 1970 would be one-third lower than 1965 excluding RDTE&S but only one-eighth lower including RDTE&S.

In addition to reducing the level of military spending, implementation of PA 3 would have a profound effect on the structure of spending. Outlays for RDTE&S would grow rapidly under either alternative, but by 1970 they would represent a larger share of total defense spending under PA 3 (39 percent) than in the absence of an agreement (27 percent). During 1965-70 investment and operating expenditures would decline under PA 3 from 14.1 billion rubles to 9.7 billion rubles but would increase without an agreement to 16.5 billion rubles.

During 1966-68, military manpower would fall from 3.1 million to 2.1 million called for under PA 3. In this period the savings on personnel costs would amount to about 4 billion rubles compared with the total savings of 13 billion rubles.

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Table 2

USSR: Military Expenditures Under PA 3
1965-70

Category	Billion of Rubles					
	Expenditures					
	1965	1966	1967	1968	1969	1970
RDTE&S	<u>4.08</u>	<u>4.42</u>	<u>4.79</u>	<u>5.19</u>	<u>5.63</u>	<u>6.10</u>
Procurement						
Land Armaments	.17	.15	.13	.12	.12	.12
Ammunition	.17	.15	.13	.12	.12	.12
Naval Vessels	.41	.37	.38	.30	.30	.30
Aircraft	.98	.88	.79	.71	.71	.71
Missile Systems	1.40	1.26	1.13	1.02	1.02	1.02
Electronic Equipment	.63	.57	.51	.46	.46	.46
Nuclear Weapons	.75	--	--	--	--	--
Other Procurement a/	.56	.50	.45	.40	.40	.40
Total Procurement	<u>2.07</u>	<u>3.88</u>	<u>3.47</u>	<u>3.13</u>	<u>3.13</u>	<u>3.13</u>
Facilities	<u>.70</u>	<u>.63</u>	<u>.57</u>	<u>.51</u>	<u>.51</u>	<u>.51</u>
Total Investment	<u>5.77</u>	<u>4.51</u>	<u>4.04</u>	<u>3.64</u>	<u>3.64</u>	<u>3.64</u>
Personnel	4.59	4.13	3.72	3.35	3.35	3.35
Operation & Maintenance	3.71	3.34	3.01	2.71	2.71	2.71
Total Operating	<u>8.30</u>	<u>7.47</u>	<u>6.73</u>	<u>6.06</u>	<u>6.06</u>	<u>6.06</u>
Total Defense Including RDTE&S	<u>18.15</u>	<u>16.40</u>	<u>15.56</u>	<u>14.89</u>	<u>15.33</u>	<u>15.80</u>
Total Defense Excluding RDTE&S	<u>14.07</u>	<u>11.98</u>	<u>10.77</u>	<u>9.90</u>	<u>9.70</u>	<u>9.70</u>

a. Includes general purpose vehicles, organizational equipment, supplies and equipage.

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III. Impact on the Economy of Reduced Military Spending

The reduction in military spending under PA 3 of some 26 billion rubles during 1966-70 would give the Soviet leaders an option of increasing the annual rate of economic growth by 0.15 percent (through increasing investment), or of increasing the annual growth in household consumption per capita by 0.9 percent, or some combination of the two.

A. Increasing the Rate of Growth in GNP

For the purposes of this report it is assumed that, in the absence of a disarmament agreement, trends in labor and capital and in factor productivity -- output per unit input of labor and capital combined -- would result in an average annual growth in GNP of about 4.5 percent during 1966-70.* This figure for the growth of GNP assumes for illustrative purposes that defense spending will remain a constant share of GNP. Given implementation of PA 3 and allocation by Soviet planners of all savings to investment, the rate of growth of capital stock would increase from 8.5 percent to 9.3 percent per year. Inputs of labor and factor productivity would be unaffected, but the growth rate of GNP would then be raised from 4.5 percent to 4.65 percent per year. This response of GNP to additional investment is relatively weak because with little or no reduction in growth of military RDTE&S the quality of resources

* Details on trends in factor productivity and on the projection procedure are presented in the Appendix.

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released from the military under PA 3 would be approximately the same as the average quality of resources currently used for civilian investment.*

The growth rate of GNP would be far more responsive to an increase in factor productivity than to a straight increase in average-quality investment. An increase in the growth of factor productivity of 1.0 percent would raise the growth rate of GNP by 1.0 percent -- in that case, GNP would grow at 5.5 percent annually rather than at 4.5 percent. In order to raise factor productivity and get more GNP growth from a given addition to investment, the resources released from the military must be of higher quality than implied under PA 3. Although a precise quantitative response of factor productivity to the quality of investment cannot be specified, a clear relationship between the two is apparent for the USSR since 1950.

The rate of growth of factor productivity was about 3 percent annually during 1951-58, a period when defense expenditures were relatively constant and when outlays on military RDTE&S represented only 6 percent of total defense spending. By contrast, the growth of factor productivity fell to about 1 percent annually during 1958-65, when defense expenditures were accelerated and when military RDTE&S increased by two and one-half times and represented 17 percent

* The quality of military resources is generally superior to that of resources in the civilian economy. It is believed, however, that the resources released from military operations and from production of military hardware under PA 3 may be of the same general quality as the high priority civilian investment in the current five year plan, such as chemical plant and equipment.

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of total defense spending. The extra-scarce, high-quality men and materials that went into military RDTE&S during the latter period deprived the civilian economy of the inputs needed to sustain the growth in factor productivity. For example, during 1958-65 the number of advanced degree holders in the USSR increased at an average rate of about $5\frac{1}{2}$ percent annually, whereas outlays on military RDTE&S rose at an average rate of about 14 percent annually, suggesting that a disproportionate share was directed to the military. It is believed that during 1966-70 expenditures for RDTE&S will continue to expand and that growth in factor productivity will remain at about 1 percent annually.

Implementation of PA 3 probably would not release the kind of resources that could accelerate the growth of factor productivity in the USSR. Expenditures for RDTE&S through 1970 would increase at a rate (8.4 percent) higher than the rate of increase in advanced degree holders, and many high-quality men, machines, and materials would continue to concentrate on military research and development and space activities. This high concentration on RDTE&S would interfere seriously with the introduction of new technology in the civilian economy. The impact would be critical in such areas as new chemical processes and semi-automated machinery, where the requirements for modern, sophisticated equipment compete directly with the requirements of a space-age armaments industry.

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Thus, under PA 3 the civilian sector probably would continue to be short-changed in favor of the military and a significant increase in factor productivity would not be forthcoming.

B. Increasing Household Consumption

In the absence of a disarmament agreement, Soviet military expenditures would grow as indicated in Table 1 and investment and GNP would increase at average annual rates of about 8.5 percent and 4.5 percent, respectively. Under these conditions, per capita consumption would increase at an average rate of 0.9 percent annually through 1970. If the Soviet leaders should decide to allocate all of the military savings under PA 3 to consumption, the rate of growth in per capita consumption would be about 1.8 percent annually. Although this alternative use of military savings would be immediately beneficial to the Soviet consumers, it would be at the expense of a slight increase in the growth of GNP (i.e., the growth in GNP would remain at 4.5 percent per year rather than increasing to 4.65 percent annually as estimated in II.B., above).

There has been a downward trend in the growth of household consumption in the USSR since about 1960. During the decade of the 1950's, the annual average increase in per capita consumption was about 3.5 percent. Since 1960, the rate of increase in per capita consumption averaged about 2.0 percent annually. The boost to consumption under PA 3, therefore, suggests only an arrest in the decline in consumption growth rather than a noticeable increase.

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C. Contribution of Savings Under PA 3 to the New Five-Year Plan

The increases in GNP that would result from savings under PA 3, although disappointingly small in the aggregate, might appear more important as marginal contributions to the recently announced Soviet five-year plan for 1966-70. It was conceded in the announcement of the plan that the resources taken for defense purposes hamper general economic growth and that "further growth of the defense might of the Soviet Union" is required in the new plan period. At the same time, the leadership is making a determined effort to regain the economic momentum of the 1950's by planning a rate of growth in GNP estimated at $6\frac{1}{2}$ percent to 7 percent annually. If defense expenditures should decline as called for by PA 3, the Soviet planners would examine carefully the alternative uses of the released resources. Some of the resources might provide a substantial boost for the most important areas of investment, and would tend to make PA 3 more attractive to Soviet planners than suggested by the possible 0.15 percentage point increment to the growth in GNP.

The released resources might be particularly welcome to help meet promises to increase consumer welfare. If all of the savings were used for consumption, the rate of increase in per capita consumption under PA 3 would be twice the rate of increase in the absence of an agreement. This doubling would definitely be attractive to the hard-pressed Soviet leadership.

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IV. Impact on Industry

Reduction of military spending would bring both new problems and new opportunities to the Soviet leadership. The laboriously prepared five year plan (1966-70) would have to be recomputed to absorb the resources released under PA 3. It seems likely, however, that the high rates ($6\frac{1}{2}$ to 7 percent) of growth planned for GNP will not be achieved and that adjustments in the plan will have to be made anyway to accommodate a lower rate of growth. Under these circumstances, the resources released under PA 3 would be a windfall, and the adjustments necessary to reallocate them would be relatively easy to make.

In the past the USSR has solved the problems of conversion from military to civilian production. During the massive reconstruction following World War II, the share of defense fell from about 40 percent of GNP in 1944 to approximately 10 percent in 1948. More nearly analogous to the situation that would obtain under PA 3 was the experience following the Korean hostilities, when the share of military spending fell from 15 percent in 1950 to 13 percent in 1955 and further to 10 percent in 1958.

All sectors of the economy supply a portion of their output directly to the armed services, but industry is particularly involved. Within industry the shipbuilding, aircraft, electronics, ordnance, missile, and nuclear energy industries are most heavily committed. Examination of several of these major Soviet defense industries suggests that in 1966-70, as in earlier periods of history, conversion generally could be relatively easily accomplished.

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A. Aircraft Industry

The proposed reductions in expenditures on aircraft would present a number of minor problems for the Soviet aircraft industry. Currently only a small part (15-40 percent) of capacity is used for production of aircraft, and about 20 percent of this capacity is allocated to civil aircraft. Thus a 10 percent cut in military production would affect less than 1.5 percent to 4.0 percent of the industry's total capacity. The Soviet aircraft industry has experience in adjusting to much more drastic declines in military demand. Production of military aircraft declined from 2.7 billion rubles in 1955 to 0.9 billion rubles in 1959, or at an average rate of 24 percent a year. In three of these years, expenditures fell about 0.4 billion rubles, and in 1957 the decline amounted to 0.6 billion rubles. In contrast declines under PA 3 would be about 0.1 billion rubles.

The plant, equipment, and labor force released would be much more easily adaptable to production of civil aircraft than to any other civilian item. Since World War II most Soviet airframe and engine plants have produced some consumer goods, chiefly items made of metal. Such production is inefficient relative to that performed in plants engaged primarily in manufacturing consumer goods, however, and is carried on only to avoid periodic unemployment in the aircraft industry.

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Workers would be released under PA 3 at a faster rate than they could be absorbed at plants producing civil aircraft. Many of the items used in aircraft production require long lead times for procurement, and an airframe plant programmed for a certain rate of civilian production cannot substantially increase that rate on short notice. Thus there would be inevitable delays in transferring workers from military to civilian production.

In the course of several years all of the workers could be transferred, thereby permitting major increases in production of civil aircraft. At present about 80 percent of total Soviet expenditures for aircraft is estimated to be allocated to military aircraft. The effect of transferring the reductions in military expenditures under PA 3 to the production of civil aircraft would be as follows:

	<u>Percent of Total Expenditures for Aircraft Production</u>		<u>Percent Increase in Expenditures for Civil Production</u>
	<u>Military</u>	<u>Civil</u>	
1965	80	20	n.a.
1966	72	28	40
1967	65	35	25
1968	58	42	20

Such rapid increases in expenditures for civil aircraft would involve a major expansion of civil aviation programs.

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The duration and cost of converting plant and equipment to production of civil aircraft or consumer goods would depend on the degree of change involved, but in no case would exceed half the time and cost necessary to construct an entirely new plant for the same purpose. For example, a shift from military training planes to civilian aircraft would require very little time and resources, whereas converting a plant producing more sophisticated military aircraft to output of civil aircraft could not be accomplished without considerable delay. Similarly, a switch from aircraft to consumer durables would require substantial time and some new equipment. However, much of the material, aluminum, for example, currently flowing to aircraft plants for military production would continue to be delivered to the same plants to be fabricated into civilian aircraft or other items.

B. Electronics Industry

Implementation of PA 3 would produce only negligible conversion problems for the electronics industry and would present an attractive opportunity for more rapid expansion of consumer and industrial electronics. An appreciable conversion from military to civilian production probably would be used: (1) to accelerate technical advance in industry (through automation and greater application of computers), (2) to eliminate the current serious lag in installations of communications facilities, and (3) to accelerate output of consumer electronics. The plan for production of military and nonmilitary electronics taken together

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probably would remain unchanged, but the share of consumer and industrial electronics would increase from less than 25 percent in 1965 to 34 percent in 1966 and to almost 60 percent in 1970.

The electronics output released under PA 3 would have a very substantial impact on any single non-military sector. For example, production of consumer electronics planned for the period 1966-70, primarily radio and TV receivers, could be more than doubled. Alternatively, planned production of electronic computers could be increased by a factor of four to five, or planned production of civil communications could be expanded by a factor of five to six. Finally, planned production of electronic instruments could be increased by a factor of more than eight. It is not likely that the Soviet leaders would single out any one of these alternatives, but they probably would give some priority to production of electronic computers and electronic instruments, including items necessary for automation.

Plant, equipment, materials, and labor (including skills) employed in the Soviet electronics industry can transfer quickly and easily from military to civilian output and back again. Military electronics plants typically are well lighted and well ventilated, and they are equipped for bench assembly operations under labor-intensive conditions. They could be converted quite readily to production of nonmilitary electronics and probably to production of

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many other items of light industry. Furthermore, only partial conversion of plants currently producing military items would be required because the high rate of growth planned for the industry would allow the Soviets to adapt planned expansions to civilian uses. Personnel in this industry generally are skilled in precision hand work, and almost all could continue to use their skills at their present places of employment. Material released from production of military electronics would be readily useable in production of civilian electronics, and could also be absorbed easily by other sectors of the economy.

C. Missile Industry

Implementation of PA 3 would pose no major problems of converting the Soviet missile industry to civilian uses. Even without a disarmament treaty Soviet authorities have chosen to reduce output during 1963-65 at a rate close to that called for under PA 3. Further cuts in production of ten percent annually from the lower 1965 base would, in absolute terms, be little more than half the size of cuts actually made in recent years.

A substantial portion of plant, equipment, and personnel currently producing missiles could transfer easily to production of civilian items. Some of the facilities can be converted easily to civilian production while maintaining the potential for reconversion to output of missiles on relatively short notice. Most missile frame plants and missile sub-contractors could be converted to production of civilian items such as consumer durables and farm machinery.

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Missile engine plants, static test facilities, and several large missile plants would have to be maintained as producers of military hardware with no capability for civilian output. They could be converted to civilian use only at substantial cost and with little change of reconversion on short notice. It is extremely unlikely that any use could be found for the facilities now used for testing rocket engines. Soviet authorities probably would replace old equipment at these facilities in order to maintain maximum standby capability for production of military items. If they chose instead to convert these plants to civilian output, 6 to 12 months would be required and the cost would be high, because most of the specialized machinery and equipment would have to be replaced. Even then the facilities would be best suited for work on projects such as supersonic transports, commercial ram-jet engines, and commercial rocket engines -- items with uncertain demand during the next five years.

D. Atomic Energy

Disruption of Soviet atomic energy facilities under PA 3 would be far more extensive than in any other industry affected. Not only would required cutbacks be much greater, but the industry would have more difficulty adjusting to a reduction in military demand. A very large share of the output from nuclear facilities is uniquely military in nature. Furthermore, the major item of civilian output is electric power -- an item that would be in surplus supply under PA 3 because its consumption by gaseous diffusion plants, reactors, and uranium beneficiating plants would decrease.

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Most of the inputs into atomic energy and nuclear weapons programs could serve no alternative purpose. Exceptions are manpower, certain power stations, some mining and scientific equipment, and various chemicals. Uranium mines and mills, facilities to convert concentrates to metal and uranium hexafluoride (UF_6), production reactors, gaseous diffusion plants, chemical processing plants, and installations for developing, manufacturing, and testing weapons could not be transferred to other employment. It would be many years before the USSR would have need for existing weapons facilities to provide raw materials and fissionable materials for a peaceful nuclear program. Very small quantities of plant, equipment, and scientific instruments could be used elsewhere, but not as effectively as in their present employment. If the USSR were to close all facilities involved in the production of nuclear weapons, probably more than 85 percent of the net fixed capital stock would have no alternative employment.

The uranium mines and mills in the USSR and the European satellites, capital items whose value probably exceeds \$1.5 billion, would substantially reduce their rate of operation. With a large surplus of concentrates already available, it will be at least a decade before these facilities are needed to support a solely peaceful nuclear program. Some mines would continue to operate at a minimal level necessary to prevent losses of ore, and some mining and milling equipment would find application in other sectors of the mining industry. Nevertheless, a large portion of the production potential of mines and mills would not be used.

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With few exceptions, the dual purpose reactors, which provide power as well as plutonium, would have to shut down. At some plants, plutonium would continue to be produced for future use as fuel in nuclear power reactors. Eventually some of the reactors may operate at full capacity again, but others may have to be abandoned completely in the absence of a demand for their output.

Several facilities for the Soviet nuclear weapons program are currently under construction. Probably all of them can be completed by 1968 at a cost of 75-100 million rubles.* The new facilities probably will be much more efficient than the old, and they almost certainly will be completed, even if a cut-off in production of nuclear weapons were agreed upon in the very near future.

Of the approximately 170,000 employees** directly engaged in the Soviet nuclear program, probably about half would be transferred out of the program. At least 30,000 are employed at scientific institutes where research and supporting activities in the nuclear energy field would be continued. A few thousand more are employed in operation of civilian facilities such as the Beloyarsk and Novovoronezh nuclear power stations, a water desalination plant on the Caspian Sea coast, and the Lenin icebreaker. Caretaker employees would be required to maintain and/or operate at low levels uranium mines and mills,

* This ruble cost is equivalent to about \$150-200 million. The exchange rate appropriate for nuclear weapons programs is about 0.5 ruble to one dollar.
** Includes workers engaged in mining and processing uranium ore in the European satellites.

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concentrating plants, gaseous diffusion plants, and chemical processing plants.

A large part of the cut-back would be in mine employment. Possibly more than 50,000 employees in the USSR and 35,000 in the European satellites would be released from uranium mines and mills, but they have skills that would be useful in non-uranium mining operations. Most employees in other nuclear industry activities also have skills that could be transferred to other industries.

Cessation of fissionable materials production would release large quantities of electric power for other use and would result in sizeable surpluses of power in some regions surrounding large gaseous diffusion plants. The nuclear industry of the USSR has consumed roughly 10 percent of the national output of electric power, principally at gaseous diffusion plants, and projections for the next few years suggest a continued growth of consumption.

The impact of PA 3 on the electric power industry would be substantial in a few regions. For example, it is estimated that the Verkhnevolinsk gaseous diffusion plant accounts for about 20 percent of total power consumed by industry in the Urals. If this plant ceased operations, it would be at least three years before other consumers would need all of the additional power that would become available. However, the added supply of power could be readily used within this region which imports high cost energy from other regions. Nuclear facilities at Tomsk consume about 25 percent of the electric power used by industry in

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West Siberia. It would be at least three years before the power requirements of other industries (mainly steel and coal) would expand sufficiently to absorb the power that would be released at the Tomsk facilities. After this three year period, however, the surplus of power in West Siberia would have disappeared and, in time, all the dual purpose reactors at Tomsk would be generating electricity for non-nuclear consumers. In East Siberia two gaseous diffusion plants now account for more than 55 percent of total power consumption. It might be ten years before Soviet planners could find suitable uses for this power.

A reduction or elimination of demand for chemicals by the nuclear industry would have only a minor impact on the chemical industry as a whole. Even chemicals that the nuclear industry requires in relatively large quantities could be easily diverted to other uses. Surpluses would arise in only a few cases, such as graphite, heavy water, lithium compounds, and possibly fluorine.

The Soviet nuclear industry has important needs for a variety of metals -- ferrous alloys, lead, copper, calcium, and nickel. Annual requirements for some of these amount to thousands of tons, but reallocation could be accomplished with only temporary dislocations. Cessation of weapons production, however, probably would result in closure of some facilities producing calcium, lithium, zirconium, hafnium, and beryllium.

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APPENDIX A

Projection of GNP

Possible trends in inputs of capital and labor and in factor productivity form the basis for the 4.5 percent growth rate projected for GNP in the absence of a disarmament agreement during 1966-70. Capital, labor, and factor productivity were projected at rates that reflect long run trends and recent developments. Given the projected trends in inputs and in factor productivity, projections of GNP were made by using a basic Cobb-Douglas production function. This function is of the form: $GNP = AL^b K^{1-b}$ where A is factor productivity L is the labor force, K is the capital stock, and b(0.75) is a constant estimated by analogy with the United States. The function implies a linear relationship between relative changes in output, inputs, and factor productivity.

Growth of input of labor is projected at 1.8 percent a year, the same rate as the adult population. This rate of growth constitutes a slight acceleration over the recent past. The growth of labor inputs during 1956-65, in terms of man-hours, probably averaged little more than 1 percent per year even though the civilian labor force was growing at approximately 2 percent per year. The disparity between growth in the labor force and in manhours worked was largely the result of reduction in the workweek. No further reduction in the workweek is expected before 1970.

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Growth of fixed capital is projected at 8.5 percent a year, a rate intermediate between the long term (1928-64) rate of 7.5 percent a year and the rate of approximately 10 percent a year experienced in the more recent past (1950-64). It seems likely that during 1965-70 there will be a tendency for growth in capital stock to decline toward the longer term rate. In 1960-64 the rate had already dropped to approximately 9 percent a year. Even this growth was sustained only by reducing retirements to very low levels -- a reduction that cannot be pushed much further. Rates of growth of gross investment have exhibited a marked tendency to decline in recent years, specifically, from 14.3 percent a year in 1955-59 to 8 percent a year in 1960 and to approximately 6 percent a year in 1960-64.

It is assumed that factor productivity will grow at about 1 percent a year during 1966-70, about the same as the rate in 1958-65. Probable expenditures on military RDT&S will continue to absorb the highly skilled personnel and complex machinery needed to raise factor productivity in the civilian economy. It is unlikely that the high growth rate in factor productivity of 1951-56 (3 percent) could be achieved unless the entire Soviet system of economic administration were radically reformed to achieve greater efficiency. On the other hand, it seems more likely that the decline in productivity growth to about 1 percent experienced in recent years was not a temporary drop but a new trend that will continue in the future. There is some evidence that the high

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rates of growth in factor productivity in the USSR during 1928-40 and again after World War II may have resulted in part from a declining average age of capital stock, a condition that is associated with a reduction in the disparity between best and average techniques. If, as seems likely, a substantial portion of factor productivity growth in the past has been attributable to this source, prospects for further rapid increase are dim. By the early 1960's the average age of Soviet capital had fallen to such low levels that further substantial reductions were not possible. Furthermore, if the rate of growth of capital stock is not maintained during 1966-70, the average age of Soviet capital may actually begin to rise and in turn exert a drag on factor productivity.

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